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House, home and transforming energy in a cold climate

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Warm homes are fundamental to a sense of personal security and citizenship, but many low-income families and households struggle to pay their energy bills, and energy prices are caught up in the politics of welfare and climate change. Our research uses a sociological perspective to investigate the experiences of low-income households, on a Glasgow housing estate, living through a major renovation programme to insulate homes and install community heating. The Housing Association's aim was to combine amelioration of fuel poverty with reduced greenhouse gas emissions. We examine the complex results from the renovation, which indicate that the UK economistic model of households as primarily consumers limited, rather than facilitated, the achievement of desired co-benefits for welfare and environment. We show the centrality of personal and domestic relationships to the future of affordable, secure and clean energy. We suggest that social scientists have an important contribution to public understanding of connections between families and relationships, localities and the politics of energy and environment.

key words housing • fuel poverty • consumers • energy • welfare

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Introduction

The Wyndford estate in Maryhill, Glasgow, is a 1960s award-winning multistorey and low-rise housing development, with 1,910 homes. Our article[2] examines householders' experiences of the first major renovations at the estate, taking place in 2012/13, and comprising a £14 million community heating system and a £10 million housing insulation programme. We consider how the improvements interacted with meanings

of home, personal control and energy use, and the consequences for the envisaged climate and welfare co-benefits. The key objective of the renovations was to remedy fuel poverty, but the programme was developed in the context of climate and energy policy concerned with reducing greenhouse gas (GHG) emissions from households.

In the UK heating and hot water for buildings make up around 40% of energy consumption, resulting in a fifth of GHG emissions (UK Committee on Climate Change, 2016). Two thirds are attributed to households, and occupants are regarded as having significant responsibility for contributing to energy savings. This means that families and households are treated not just as an inter-personal sphere, but also as entities in a technocratic model of energy demand 'in a decontextualized energy system in which end users' buildings, appliances, and behaviour all have a theoretical optimum energy performance' (Johnson, 2016: 95). Low-income households, such as those at Wyndford, are in an ambiguous position in relation to this model. Rules governing energy markets define them as 'debt risks', rather than as consumers with capacity to manage energy demand in response to new information. At the same time welfare policy treats them as 'under-consuming' energy with negative consequences for health and welfare (Public Health England, 2014). Social housing improvements through better insulated buildings and cleaner heating systems with new technical controls and meters are expected to make homes easier and more affordable to heat, thus improving both welfare and climate protection. Assembling the finance for such interventions is, however, made more difficult by the definition of families and households living on low incomes as 'debt risks'. The Wyndford renovations were hence a matter of long-term planning, but nevertheless aimed to secure the co-benefits of welfare and clean energy for the residents.

The Wyndford estate was built by the Scottish Special Housing Association (SSHA)[3] on the site of a former army barracks, and the old perimeter wall helps retain the

Photograph 1: A view of the Wyndford estate from outside 'The Barracks' wall

identity of the place, still known locally as 'The Barracks'. The new housing was extremely popular with its working-class tenants, described as "a dream come true" by one tenant who has lived there since 1964, and the whole estate was regarded as having a formidable 'community spirit' (Damer, 2013). As in many similar estates, the picture of Wyndford life now is mixed: affection and continuing attachment combine with a sense of decline and social dislocation; many live in poverty and endure poor mental and physical health, and there are high rates of drug and alcohol problems. Nearly 50% of adult residents are not in employment, and a significant part of the estate falls into the 2% of the most deprived areas in the UK (McCrone et al, 2012). In this article we discuss findings from our longitudinal survey of householders' experiences of the social relations, technicalities and economics of the renovations, and their significance for climate and energy policy. We consider lessons for actions to secure the co-benefits envisaged in policy between social welfare, climate protection and the creation of more sustainable societies.

Social relations of home, economy and energy use in a market society

In common with many similar British estates, the physical and social fabric of Wyndford deteriorated with economic recessions and rising unemployment in the 1980s and 1990s, and with the dismantling of welfare provisions. In the 1960s, housing was conceived as a public good in a social contract between citizen and state. The SSHA pursued this ideal rigorously, using 'hands-on' management to create a cultural identity of working-class respectability, security and cohesion embedded in home, family and personal relationships. Prospective tenants were nominated from a General Needs waiting list maintained by the Glasgow Corporation, but were interviewed and selected by SSHA officers. Those chosen were expected to meet high standards of conduct, paying rent on time to their rent collector, and maintaining clean and tidy flats, landings and stairs. In return, SSHA undertook to provide a high standard of service to households, including advising on benefit entitlements and supporting anyone experiencing difficulties (Damer, 2013).

By the time Cube Housing Association bought the estate for £5 million in 1994, housing had become integral to UK government strategies to stimulate economic growth through consumer markets and household borrowing and spending (Bowman et al, 2014). At Wyndford, for example, 564 houses, mainly maisonettes, have been sold under Right-to-Buy legislation. The governance of social conduct has also evolved from a focus on shared responsibilities of work, citizenship and family in a welfare state to a focus on individualised responsibility for competitive choices in a market for goods and services (Miller and Rose, 2008). 'Home' and family have themselves been targeted as a market opportunity for differentiated 'lifestyling' and retailing (Du Gay, 1996). Energy and climate policies directed at families have adopted this consumer model through use of market incentives and information to 'nudge' choices towards more 'sustainable lifestyles' (Shove et al, 2012; Webb, 2012). In heating systems, such as those introduced as part of Wyndford housing improvements, devices such as smart meters, central heating programmers and thermostats are promoted as a means to make people into the economically rational consumer imagined in technocratic models of efficient energy systems (Abi Ghanem and Mander, 2014).

A growing body of social science research has demonstrated the inadequacies of this model as a means of understanding the complex family relationships, personal

biographies and networks of friends and neighbours in which energy use is embedded (McMichael and Shipworth, 2013; Groves et al, 2015). 'Energy demand' emerges as a phenomenon constituted by habituated social practices, valued cultural identities, marketing and socio-technical systems (see, for example, Darby, 2003; Shove et al, 2012; Strenger, 2013), rather than by an abstract economic calculus of price and cost efficiency. Social practices concerned, for example, with being hospitable to family and friends are inter-twined with using energy for heating, lighting, cooking and entertainment. New energy management devices such as 'smart' meters do not replace these practices and their meanings with an economistic calculus of energy demand, but tend instead to be domesticated into household routines structured around comfort, cleanliness and convenience; nor do they provoke deeper concern about, and engagement with, climate change (Hargreaves et al, 2013).

Such practices are not 'ready-made' institutions conferred on a passive subject; they are actively constituted and reconstituted through social interactions and personal biographies, and work as components of self-identity: they 'create expectations, produce feelings of autonomy by encouraging mastery of competences and reinforce connection with others through shared meanings' (Groves et al, 2016: 313). Capacity to reflect on, and change, energy use is thus likely to require circumstances that create the means to form renewed, and possibly different, social connections, to extend a sense of agency, and to build on personal biography and relationships to understand the potential for, and value of, making changes.

Much of the research on households, energy and sustainability has, however, focused on people whose economic status confers a degree of discretion over disposable income. Research on low-income households' experiences of, and responses to, energy saving initiatives, new heating controls and associated narratives about climate change and sustainable consumption is limited. Nor has social research typically considered the tensions between understandings of home as 'a repository for complex, inter-related and at times contradictory socio-cultural ideas about people's relationship with one another … and with places, spaces and things' (Mallett, 2004: 84), and the increasing incursion of consumerism into that sphere.

Although the sense of security often associated with home does not depend on private ownership, it is related to ability to exert some control over domestic space (Kearns et al, 2012). Experienced control is now, however, closely associated with disposable income, and low incomes severely restrict the scope for such control. Ironically, living on a low income, in a residualised welfare state, makes people 'economically rational energy consumers' as a matter of necessity: the poorest 10% use less than half the energy used by the richest 10% (Druckman and Jackson, 2008: 3183), but spend a high proportion (over 10%) of their income on energy bills. This is twice the proportion spent by all households, and three times that of the highest income decile (ONS, 2014, Table 3.2). Although this energy rationing is associated with ill health, such control may also serve as a (perhaps perverse) component of personal dignity and security. The biographical meanings of energy consumption, and relationships to a sense of personal security, are therefore complex for those getting by on very little. They must manage the vulnerability created by negative public attribution of a flawed consumer identity, with limited competence and capacity as a buyer of goods and services (Bauman, 1998), while living in a materialistic society where political discourse blames the poor for their situation.

Major interventions not necessarily chosen by households, such as the Wyndford renovations, hence seem likely to interact in complex ways with routines for personal security that people have managed to assemble. Housing renovations may contribute to self-respect and dignity, ameliorating some damaging forms of control, such as the energy rationing associated with structural poverty. Housing and heating renovations have been associated with improved mental health (Gilbertson et al, 2012), as well as reduced use of health services and medication (Platt, 2007). In the short term, however, evidence of improvements to physical health has been lacking (Thomson et al, 2001; Braubach et al, 2011; Liddell and Morris, 2010). In addition, the complex psycho-social processes governing the meanings of energy use, home and poverty suggest that achieving the desired benefits is likely to depend not just on the technical upgrades to buildings and heating systems, but also on the social relations of tenants, landlords, owner-occupiers and energy suppliers before, during and after the programme of work. We consider how these social processes worked out at Wyndford, and the implications for gaining the envisaged climate and welfare co-benefits.

Methodology

Since the primary aim of the renovations was to tackle fuel poverty, our research focused principally on a structured before and after comparison of household experiences of old and new heating and costs, as well as relationships with Cube and the new energy supplier. We began with 15 pilot interviews to help construct a structured 48-item questionnaire, mainly using closed, multiple choice and Likert scale items, but including a few open-ended questions. We then selected 10% of

Table 1: Summary of sample compositions in Wyndford Householder Survey

Key characteristics		Tenants	Owner-occupiers
Lead respondent: Age	Median age	46	51
Sex	Male	69%	34%
	Female	31%	66%
	Total	100% (*n*=154)	100% (*n*=50)
Occupational status	Employed	24%	36%
	Non-employed	51%	10%
	Retired	25%	54%
	Total	100% (*n*=154)	100% (*n*=50)
Length of time in house	0–5 years	47%	10%
	6-10 years	24%	14%
	10+ years	29%	76%
	Total	100% (*n*=153)	100% (*n*=50)
Household size	1 person	60%	44%
	2 people	26%	28%
	3 people	8%	16%
	4–5 people	6%	12%
	Total	100% (*n*=154)	100% (*n*=50)

households (154 tenants and 50 owner-occupiers) based proportionately on each type of housing, from 26-, 14- and 12-storey flats to maisonettes and sheltered accommodation. Working with a team of trained graduate researchers, interviews were conducted at home with a lead respondent, just before, or when, their houses were renovated (see Table 1 for summary of sample compositions).

Eighty tenants and 39 owners (based on availability) were re-interviewed one year after renovations were complete, providing a Time 1/Time 2 comparison. The Time 1/Time 2 samples were broadly comparable demographically, with a slight tendency for tenants re-interviewed to have lived longer on the estate. Repeat interviews added questions about the new heating. The longitudinal study thus avoided the flaws of retrospective comparison.

Further evidence was provided by interviews with three Cube officials, three energy company managers and a local politician; we also worked with a consultant who provided a brief ethnographic history of Wyndford. We have subsequently discussed our findings with Cube, the energy supplier SSE and Glasgow Council officials and elected members.

In the sections below, we first outline the structuring of the renovations. We then move on to analyse householder data, based on those interviewed twice, and discuss incomes, personal security, social relationships and attachment to home in the context of the renovations.[4] We consider the complex interactions between using the new heating and paying for energy, and explore four household vignettes to exemplify different experiences.

Housing and heating renovations at the Wyndford estate, Glasgow

Cube Housing Association had struggled financially since purchasing the estate in the 1990s, and there was a common narrative among residents that it had not shown proper care for the social and physical fabric (Damer, 2013). In 2008 an 'energy efficiency options appraisal' was commissioned from the Mackintosh Environmental Architecture Research Unit at Glasgow School of Art, as part of an ambition to integrate social, environmental and economic benefits, although:

> 'The main thing was around the fuel poverty issue. We actually had hoped at that point, taking the ten per cent definition of fuel poverty, we'd actually hoped to eliminate fuel poverty…. I was always crazily optimistic.' (Cube regeneration manager)

The final programme took a further four years to negotiate, with finance posing major difficulties. In addition, Cube declined to be the heating and hot water supplier, and eventually negotiated a 30-year concession contract with SSE for construction, operation and maintenance of the system, as well as metering and billing. An important component of the eventual finance relied on the price offered for forecast carbon savings under the UK government energy company obligation (ECO). This works as a levy on bills, creating a fund that suppliers must invest in household energy efficiency. Although initially conceived as part of climate policy, the expected welfare co-benefits mean that ECO has increasingly been targeted on amelioration of fuel poverty (Rosenow et al, 2013). For a housing association to access the fund they must demonstrate area-based/postcode eligibility, and measure carbon saving according to

techno-economic rules and restrictive timetables (Rosenow and Eyre, 2015). These rules were critical to funding:

> '… what helped the Wyndford project stack up was the fact that there was so much carbon to be saved even at that time, although we've gone way stratospherically beyond what we thought we would get in terms of grant and assistance for carbon reduction.' (Cube regeneration manager)

But the rules also imposed a rigid timetable, which meant that the majority of the construction took place during winter 2012 in a period of around four months. This remarkable feat was managed in a highly centralised fashion by Cube officers who met tenants to explain the programme, issued a letter informing them of installation dates, and reinforced this by turning up to get people out of bed and move furniture, if necessary, when the new heating was due to be installed. Not surprisingly, this command and control approach, combined with a complex chain of SSE sub-contractors, was an axis of contention in interactions, but Cube had little choice, given the 2012 funding deadline imposed by the variant of ECO then in operation.[5]

Even if the renovations had been carried out at a more measured pace, they would have been very physically disruptive. All but one of the multistorey blocks[6] was insulated through external cladding, entailing extended periods of noisy drilling. The 1960s electric storage heaters and hot water tanks were replaced with new central heating radiators, heat interface units, meters and programmers. A gas-fired combined heat and power (CHP) generator, plus three large gas boilers and a thermal store were installed in a new energy centre on the estate. Gas CHP is an established energy efficiency technology because it uses the residual heat from electricity generation, and supplies this to multiple buildings via a network of insulated, underground hot water pipes. Heat supply from the energy centre required extensive trench work for the 5 km heat network, disruption to communal areas during installation of internal pipework, and work inside every house.

Residents were overall surprisingly tolerant: only half of tenants found the work 'very' or 'fairly disruptive', and owners were even less perturbed, with only one-third finding it disruptive. This was possibly because the latter chose to opt in, were given more choice about the location of radiators, and received a grant to cover costs. Owners also had the system installed later than tenants, and the work was not constrained by ECO funding deadlines, which may have resulted in more proficient installation.

Household incomes and getting by

Resilience to the physical disruption was also associated with wider recognition that Cube was responding to long-term concerns about the cold housing, unaffordable heating and poor physical condition of the estate (Damer, 2013). Wyndford households managed on very low incomes and were spending a high proportion of income on energy. Almost three-quarters of tenants and a third of owners in our sample had gross household incomes below £10,000pa (39% of the 2012 median income of £25,960pa for Scotland; see SPICe, 2012). Owners were slightly better off: 20% had gross incomes of £20,000pa or more, compared with 6% of tenants. Among those on the very lowest incomes (less than £5,000pa), 60% estimated spending 20% of their

income on energy; this compared with less than one-fifth of those with incomes of £15,000pa or more.

The majority nevertheless described themselves as managing to get by, although again owners were doing better. Almost twice as many owners as tenants reported managing 'very' or 'quite' well financially (50% of owners, 28% of tenants); twice as many tenants as owners reported being in financial difficulty (24% of tenants compared to 12% of owners). Those having financial trouble were notably the younger (under 35), less established (Wyndford tenure of five years or less) and non-employed, but *not* retired people. Before the renovations, tenants (particularly the non-employed and those with shorter tenure, but again *not* those retired) rationed household spending to pay heating bills. During the previous winter over a quarter of tenants employed 'heat or eat' strategies, cutting back spending on food. Over a third of tenants had also borrowed money, while over a quarter delayed paying other bills. Thirteen per cent of tenant households adopted all three of these serious coping strategies in order to pay heating bills. To a much lesser degree owners also adopted these practices: five cut back on food, three delayed paying other bills and two borrowed money.

Wyndford experiences of home and the effects of the new heating

Being able to get by was associated with a sense of personal security and home. Eighty per cent of tenants and over 90% of owners considered their *house* to be somewhere they felt at *home* and safe. The estate was referred to as *The* Wyndford or *The* Barracks, reflecting distinctive social and geographical identity, and an 'elective fixity' (Paton, 2013) between people and place: tenants had lived there for a median of 12 years, and owners over 40 years, many commenting that they were happy there. This was reinforced by strong kinship and friendship networks: 75% of tenants and 90% of owners reported having Wyndford friend and/or family networks; most people saw friends and/or family daily or weekly. Although few were active in local civic associations, about half knew immediate neighbours 'very' or 'quite well'. There was nevertheless concern about social decline, usually attributed to a rising proportion of single men in the 26-storey flats, and associated drug and alcohol problems: "they don't know how to keep a house or communal area." Some said that, should the chance arrive, they would consider moving house; this was variously about a desire to be nearer to family, to access better neighbourhood amenities, or to have better services from a landlord.

Even though there was a sense of secure attachment to place and home, the transformation effected by the renovations was marked: high levels of satisfaction with their house beforehand (84% of tenants and 87% of owners) were maintained for tenants (85%) and increased for owners (to 95%). Far more significant was the major increase in satisfaction with heating. The old electric heating was widely perceived as ineffective and expensive; 40% of tenants 'rarely' or 'never' used it, and only 27% of tenants and 38% of owners regarded it as satisfactory. In contrast, 71% of tenants and 95% of owners were satisfied with the new heating, and dissatisfaction also fell sharply (Figure 1).

Figure 1: Comparison of household satisfaction with old and new heating systems (Times 1 and 2)

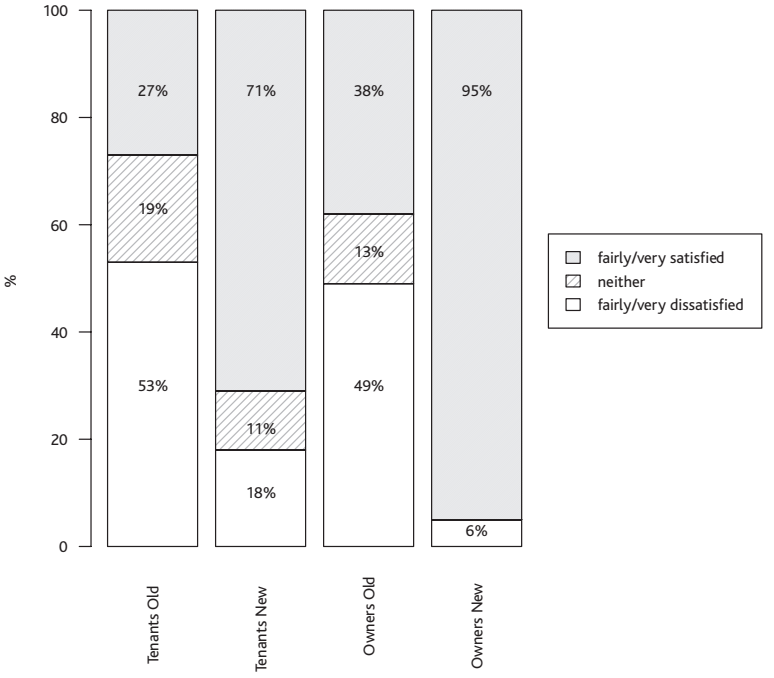
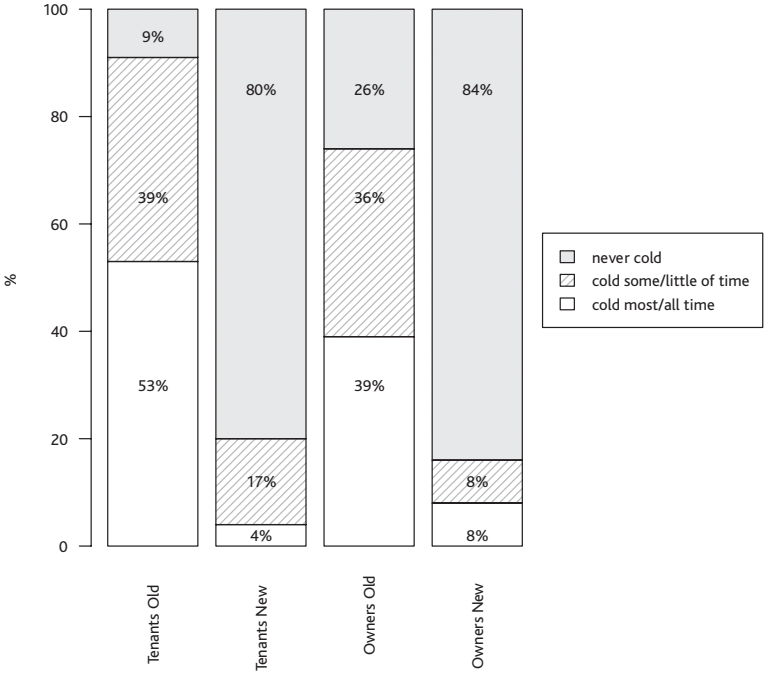


Figure 2: Comparison of households reporting being cold in their homes in winter before and after the new heating system (Times 1 and 2)



Assessment of warmth was also transformed: with the electric heating, more than half of tenants, and two-fifths of owners had been cold at home 'all' or 'most' of the time the previous winter. With the new heating, only 4% of tenants and 8% of owners continued to feel cold at home in winter (see Figure 2). Among tenants who were cold 'all' or 'most' of time in the previous winter, 70% were *never* cold in the subsequent winter, and the proportion who said cold housing was a 'serious' problem fell to one-third of previous levels (from 42% to 14%).

Paying for energy

Managing the cost of bills remained a critical concern. Many were sceptical about savings from the start: 41% of tenants and 38% of owners expected to pay 'more' for heating; only 32% of tenants and 24% of owners expected to pay less,[7] and there was limited evidence of people spending significantly reduced proportions of income on energy. Whether households were actually paying 'more', 'less' or 'about the same' for energy one year later is difficult to assess, however. First, they now have two bills, one for electricity and one for heat. Second, different heat metering and charging systems were in use, including direct debit, quarterly billing or a 'constant-rate payment meter', which automatically ceased supply when debt of over £10 accrued. And third, spending is affected by seasonal variation, tariff changes, discounts and debt repayments.

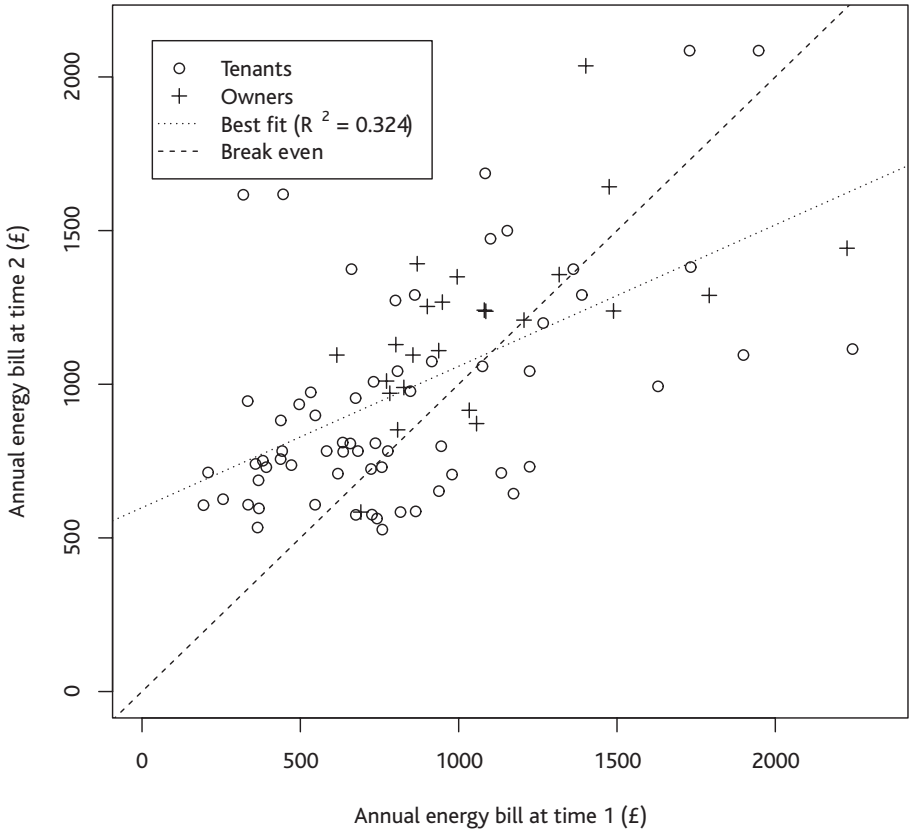
As far as possible we used actual energy bills to calculate expenditure; in other cases we relied on the household's estimate. Using these data, correcting for seasonal variation, we extrapolated to annual 'before and after' energy expenditure. This showed that the mean energy bill for tenants increased by 14% (median 8%), and for owners, by 11% (median 14%). Factoring in retail energy price increases since the new heating was installed,[8] households had made modest savings: the mean annual bill for tenants decreased by 3% (median 8%), and for owners by 5% (median increase 10%). Using data for households for whom we have reliable data at Times 1 and 2 (see Figure 3), most were spending £500 to £1,000pa on energy both before and after the new heating, and spending at Time 1 and Time 2 was highly correlated (tenants, r=0.524, p<0.001; owners, r=0.564, p=0.004). The Figure 3 'break even' line indicates equal costs at Times 1 and 2. Most households are above this line, so in nominal terms most are spending more. The 'best fit' line indicates the best-estimate linear relationship between bills at Times 1 and 2. This shows that households spending more than £1,000 at Time 1 tended to make savings, while households spending less than £1,000 at Time 1 tended to have higher costs.

Spending patterns of some households did change radically, and there were also high levels of variation between households in comparable dwellings. These patterns indicate that, although energy bills remained a major issue, spending was situated in varied household routines, life stages and values, and was not simply a matter of economic calculation. Some in similar houses may, for example, be more concerned to keep warm than to eat or vice versa; the new district heating may also mean some were spending more because they valued the warmth, whereas the ineffective electric heating was regarded as a waste of money. Conversely, higher spending may be unintended, because of unfamiliar heating controls and metering, as well as contending with two bills.

Household heating practices and socio-technical relations of heat supply and use

The situated rationality of spending on energy, in the context of family, social life and life cycle stage, is evident when we consider some particular examples, which show the limitations of a utility-maximising consumer model of behaviour. Kevin spent much of his time away from his one-bedroom rented flat; he worked shifts and visited elderly relatives in the afternoon and at weekends. The new heating, however, gave him "a better feeling of wellbeing"; he found the house a lot warmer, and liked the instant hot water for showering after work. He appeared to have the lowest Time 1 annual energy bill, but was spending almost three times this amount at Time 2, despite being out a lot. At Time 1, he used the storage heating topped up with electric heaters, and at Time 2 relied on the new heating. He thought he was using more heating, but also considered the new standing charge to be a high proportion of his bill. He set out to be a model of the calculating energy consumer, monitoring his spending through a daily spreadsheet record of the level of credit on electricity and heat meters. He has sent us a monthly copy of the data since January 2013, and this record shows the practical impossibility of enacting the rational consumer identity using the credit meter data, because it confounds forecast energy use with actual

Figure 3: Comparison of estimated household energy bills per annum before and after the new district heating system (Times 1 and 2)



consumption and its variations. The most visible data is hence a poor aid to energy saving, even for those willing to persist with such a calculus.

In another household, a four-person family living in a maisonette which they own, there was no deliberate attempt to monitor energy bills or reduce spending – "with three of us working, we didn't think of it much" (Robert) – but their bills had declined by 35% with the new heating. This family were in the 'high spending' group (see Figure 3) on both occasions; in the past, they had used three electric storage heaters and the electric immersion for hot water, which "didn't suit our lifestyle", Robert said. The three family members with jobs had different working hours, and the new heating and instant hot water suited work and home routines; it was seen as very valuable *and* was proving cheaper. In both Kevin and Robert's households, heating and energy use could be understood as a socially situated form of 'utility-maximising', but with very different orientations to the model of a rational economic consumer. Both households appreciated the new heating, and experienced their house as 'warm and cosy' for the first time. Kevin was, however, spending three times more than before despite close self-monitoring, while Robert's family were spending 35% less, although they were not trying to manage energy costs.

In more precarious economic and social circumstances, shared by many people on the estate, the interrelations of personal biography, family circumstances, and meanings of home and energy use are more troubled. The first example shares with Groves et al (2015) a theme of life course transitions: Martha worked as a full-time, low-paid, carer; now middle-aged, she had lived on the estate for 20 years, was in poor health having had treatment for cancer twice, and was now living alone. During the estate renovations she was coping with grief over the death of her husband at home, and felt daunted by all of the changes, none of which she had wanted or was in control of. Her grief and the sense of loneliness, loss of personal security and control were perhaps given a material focus in the new heating system, with its greater complexity and changed energy suppliers and bills; in her words, "it felt like they [the energy company and housing association] just dumped the new system on me." She used the heating thermostat like an on/off switch, was unsure of its costs, and turned the heating off when money ran short. The emotional damage stemming from Martha's changed life circumstances worked against a willing engagement with the heating, and she felt the lack of supportive social networks, through Housing Association or neighbours, which would enable her to interact with the renovations to regain a sense of home, comfort and getting by financially. Her heating bills had quadrupled, but the idea of economic self-interest in managing energy use appeared largely irrelevant.

There were also vulnerable adults living alone who were heavily dependent on others for social and personal support. Glenn, for example, was virtually house-bound, and "if anything, things are getting worse." He had a support worker who helped him to manage his finances, including energy bills, and relied a lot on his sister who lived nearby. His benefits had recently been reviewed, resulting in loss of his sickness benefit, and he was involved in an appeal tribunal. He thought he had received letters about the heating, but was unsure what they meant and had not kept them. He struggled to understand how the heating worked, and had problems keeping the living room radiator at the temperature he wished, but appreciated the hot water. His support worker had set the programmer, wall thermostat and radiator controls; he was unsure how to change the settings and simply left them alone. Like Martha, he felt a lack of control over his circumstances, although for different reasons. Again,

a component of that desire for control focused on the heating system, illustrated in this case by his comment that he would "prefer a wee fire". He thought he was probably in debt to the energy company, but was not sure by how much – "maybe over £700", he ventured.

Martha and Glenn were similar to others troubled by unwilled life course transitions, such as loss of jobs, loss of benefits, bereavement, worsening health conditions and difficulties managing financially. Some had family, friends or carers who helped to set the heating controls and to budget. In other cases, someone unfamiliar (a contractor, Cube adviser or SSE employee) had set the heating controls, which left people reluctant to adjust the settings. They did not feel in control of the heating or bills, often mentioning that they felt too warm or too cold throughout the house or in particular rooms, and sometimes opening windows if they were too warm.

Beyond the most vulnerable, other households also struggled to regain a sense of control over the new heating of the kind they had relied on with a single pre-pay electricity meter. The array of technical devices now installed (programmer, wall thermostat, radiator valves, payment meter and heat meter), and shifting terms used by Cube and SSE for describing these, was a common source of difficulty, and sometimes acted as a focus for wider grievances. As with Kevin, many felt the lack of direct feedback between using and paying for heating. Initially, for example, the meter showing actual use was installed inside the new Heat Interface Unit, providing real-time data to the supplier, but not to households; those who asked got the meter relocated to a visible place. Beyond this, control was subject to trial and error: 85% of tenants and 70% of owners were not using the programmer one year after the heating was installed, and around half did not use the thermostatic radiator valves. Only one householder explicitly mentioned using the heating manual. Most relied on friends and neighbours, or contacted SSE and Cube. Those who perceived a lack of consistent and reliable support from Housing Association and supplier were also *less* likely to use the programmer or radiator valves to control their heating.

It is difficult to estimate the proportion of households in serious difficulties with energy bills, but between March 2013 and September 2014, when Cube appointed an energy adviser to work with households, at least 10% were continuing to experience significant difficulties with debt and the new heating. Some described being told that their energy spending was 'out of control', but could not understand why their bills were high. Some felt disenfranchised from the process, rather than ownership of it, which spoiled trust, and said that they felt like subjects in an experiment that they had not consented to. This contributed to scepticism about the benefits and resort to the remaining negative power of self-disconnection, rooted in experiences of struggling to get by. The standing charge component of the heat tariff was regarded as particularly punitive for those who rationed use of heating, and was a particular focus for grievance and community action, described by one person as "an issue that brings everyone together." It motivated a group of residents to demonstrate outside SSE's offices; the local MSP became involved and wrote to all households to collect evidence about how much people were paying. He then held meetings with both SSE and Cube about billing and payment options and standing charges. The adviser also worked to resolve the problems, acting as an intermediary between households, Cube and energy suppliers. She provided the kind of personal contact which people had valued as part of Wyndford life in the past, displacing the anonymity and confusion of customer call centre systems, and responding to household distrust over the accuracy

of bills, and lack of understanding about low-income discounts or arranging a debt repayment plan.

Questions about the affordability of the new heating are complex: comparisons can be made on the basis of energy bills before and after; what bills would have been for the same warmth using the old electric heating; what the bills are for similar flats with a different heating system, and so on. The Wyndford heating supplier, SSE, uses a comparison based on what the current average heating use would have cost residents using the old storage heaters, and concludes that households are attaining more comfort at lower cost (SSE, 2016). Affordability remains a contentious issue on the estate, however, with one of the local councillors continuing to represent concerns, and to argue for a different tariff structure. SSE have also introduced a low heat user tariff, with a zero standing charge, and households that meet the criteria, defined by eligibility for welfare benefits, are encouraged to switch. By 2016, 131 Wyndford customers (7%) were using this tariff (SSE, 2016). Cube has also proceeded to develop a second district heating system at its Glasgow Broomhill estate, with a tariff planned to have no standing charge; this is viewed as a means to avoid the lingering problems at Wyndford.

Interaction between the welfare and environmental aims of the renovation

The primary aim of the renovations was to improve household welfare, but Cube also wanted to contribute to clean energy and climate protection. The latter ambition was not, however, integrated into the main discussions between Cube housing managers and householders in the process of planning and implementing the renovations. It was thus in the background, rather than integrated into public meetings, household visits and community events. The value of clean energy as a contribution to home, personal security and neighbourhood, and as a symbol of the Housing Association's commitment to its households, was hence not consistently understood. The new energy centre itself was not used as an opportunity for discussion about energy and climate change. Hence the personal and social value and meanings of The Wyndford as place and neighbourhood were only weakly incorporated into the renovations.

Instead, and in line with the wider economistic framing of energy and climate policy, attention has focused on price. This was not so much a matter of design as one of normal rules governing thinking about energy as a market commodity and expectations of low-income households as 'debt risks'. The economistic lens was prominent in a letter from a senior Conservative MP to the researchers, following a 2013 UK parliamentary committee visit to the estate. The MP encouraged us to investigate the scheme economics, on the grounds that the financial return was only around 2.8%pa, and "they could get the same on a Halifax Tracker." The comment reveals a perspective on social housing investment as a matter of maximising short-term financial return rather than maximising societal benefits of local regeneration and climate change mitigation.

The economistic frame also resulted in varied local responses to the climate protection aims of the renovations, compounded by the perception among some that the work was imposed on tenants, and gave insufficient priority to affordability for households. Some were cynical about claims that the heating was 'environmentally friendly' energy, which was regarded by a few as part of the "green bandwagon, enviro-

fascism" or "saving polar bears while pensioners die"; district heating advocates were described by one man as the "hippie hot water mob", and one woman described the energy centre as the "Queen Mary", about which there had been no consultation, and which was regarded by one house owner as spoiling the view. Around a quarter of our interviewees nevertheless said that local energy mattered, although the most important aspect of the new system was reduced bills and increased warmth. How or whether it mattered also differed between respondents: one person said it might mean less reliability, while another dismissed the significance of location, because energy was "all owned by foreign companies anyway." A third person said that it was only important if the profit "goes back into the community" and a fourth that local production would be important, "especially when we get our own government." The original plan for a community energy scheme, as conceived by Cube, had aimed to address all of these concerns by developing a locally owned and controlled consumer cooperative. The structure would place local relationships and democratic control, and transparency over the costs and affordability of heat, at the core. The co-op structure was also intended to support the local economy by retaining a higher percentage of energy revenues in the locality.

Affordability would also have been improved by a co-op drawing in a larger population to share infrastructure costs. In the UK energy market, district heating costs are high, relative to costs of renewing existing gas networks, because the latter are shared across the entire customer population. For district heating,

> 'That meant the costs [at Wyndford] become … very high… Most of that is to do with CAPEX, but … if that could be spread across how many millions of customers that [Utility's] got. But it's not, it's divided amongst one thousand five hundred.' (Cube regeneration manager)

Using the status of the Maryhill locality as a Transformational Regeneration Area, Cube wanted to form a partnership with another Housing Association, municipal facilities and swimming pool, a university campus and private enterprises, notably a new Tesco 'superstore' on the border of the Wyndford estate. In practice, however, Cube was unable to persuade the other organisations and proceeded alone.

Discussion and conclusions

The ambitious renovations at the Wyndford estate have become part of the story of the neighbourhood, household welfare and perceptions of district heating and housing insulation as contributors to climate protection. Households have gained significant improvements in warmth, although affordability remains contentious. GHG emission reductions have been measured as 62%, compared with estimated emissions from the old electric heating, *assuming the same level of heating* then as now (SSE, 2016). Despite the best intentions of the Housing Association to integrate social, environmental and economic principles into the work, market economics dominated the process, marginalising the potential for families and households to participate as equals in developing a sense of ownership of sustainable energy and a stake in society.

Our evidence shows the complex outcomes of the intervention, and suggests the limitations of the technocratic model for securing the desired co-benefits for welfare and climate protection. In relation to the economics of households, people were

spending slightly less on energy than they would have spent had they continued using electric heating, with its rising prices, but few reported a significant fall in proportion of income spent on energy. Households whose energy bills before the upgrade were higher did make absolute savings, while those spending less tended to have higher bills. The renovations were hence not an 'easy fix' for affordable warmth. Nor was the assemblage of heating controls, metering and billing a transparent means for people to control costs. If anything, households accustomed to their own variant of the rational consumer, through electricity self-disconnection, perceived themselves as disempowered by the new heating, with a daily standing charge that continued to accrue regardless of use. Lack of positive choice and control over their lives was also made clear to some of the tenants who perceived the system as being imposed through a timetable and method not of their choosing. The ensuing struggle to regain control was hence partly about the emotional damage of the process, an element of what Sennett and Cobb (1972) called the hidden injuries of class.

With a socialised model of energy and climate policy, families and households could instead make a critical contribution to creating more sustainable societies and neighbourhoods, of the kind which many Wyndford households recalled. The Glasgow estate is similar to many 1960s social housing estates in British cities, with diverse building types and households. Very low incomes, and poor life chances, do not prevent people from having a strong sense of home; improving the standard of housing and affordability of heating are important contributions to such ontological security and self-respect. More could, however, be gained by managing such clean energy programmes in ways that forefront the societal meanings of home, climate change and welfare, and which deliberately work to integrate, and contribute to, neighbourhood friendship and kinship networks, and a sense of shared purpose. Investments in the material technologies of housing and heating are also investments in the social and community fabric of life. The technocratic model tends to limit what can be achieved in these spheres, and to neglect the resourcefulness of households accustomed to thrift and the demands of 'getting by alright' through accomplished rationing of energy, food and other resources.

For households and neighbourhoods to act effectively requires institutional changes to create the opportunity, and responsibility, to engage with energy supply beyond the limited role of consumer. In Germany, for example, a citizens' movement is working to re-communalise energy grids in some cities as a means of democratic representation in decisions about energy and its climate consequences. Currently in the UK, the consumer model of households, and a technocratic model of the energy system, marginalises debate about societal shares of responsibilities for, and costs and benefits from, changing energy provisions. It encourages a calculating, even cynical, attitude towards government energy and climate policies. Blurring the distinction between the identities of citizen and of consumer also limits a sense of shared responsibility for the common good (Sandel, 2009). Sociologists, along with other social scientists, need to articulate the connections between the personal and domestic spheres, localities and the politics of energy and environment. As such we can engage with councils, housing associations, central governments and businesses to explain that society is more than a collection of consumers, and that a society able to respond effectively to climate change is more than a market economy.

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Notes

[1] Corresponding author.

[2] This research was one component of a four-year project on socio-technical innovation for sustainable heating in British cities.

[3] SSHA was a government body set up in the 1930s, operating at arm's-length, and responsible for building and managing special housing projects.

[4] For survey results in full, see McCrone et al (2014).

[5] At the time of our research, the Wyndford project was the largest ECO-funded energy efficiency renovation in terms of number of homes connected to new district heating.

[6] One housing block was initially excluded from the exterior insulation programme, because it was not in an eligible postcode sector.

[7] Twenty-one per cent of tenants and 30% of owners thought they would end up paying 'about the same' as before.

[8] From people's energy spending, we estimated their consumption at Time 1 in kWh and asked how much this would cost using Time 2 electricity tariffs (which had risen), thus comparing what people pay after the heating upgrade with what they would have paid in the same year had the upgrade not taken place.

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